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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/017,301	12/14/2001	Naoya Hasegawa	9281-4209	7249

7590 07/22/2004

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EXAMINER	
BERNATZ, KEVIN M	

ART UNIT	PAPER NUMBER
1773	

DATE MAILED: 07/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/017,301	HASEGAWA ET AL.	
	Examiner	Art Unit	
	Kevin M Bernatz	1773	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-16 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-16 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. 07202004 .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Preliminary amendments to claim 1, filed on May 13, 2004, have been entered in the above-identified application.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Examiner's Comments

3. Regarding the limitation(s) "functions as a back layer exhibiting a spin filter effect, thereby improving a rate of change in a resistance in the magnetic sensing element" in claim 1, the Examiner has given the term(s) the broadest reasonable interpretation(s) consistent with the written description in applicants' specification as it would be interpreted by one of ordinary skill in the art. *In re Morris*, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997); *In re Donaldson Co., Inc.*, 16 F.3d 1190, 1192-95, 29 USPQ2d 1845, 1848-50 (Fed. Cir. 1994). See MPEP 2111. Specifically, the Examiner notes that this applies to the "nonmagnetic interlayer" and that the limitations "functions as a back layer exhibiting a spin filter effect" and "thereby improving a rate of change in a resistance in the magnetic sensing element" are deemed to be met by any of the materials disclosed by applicants as being suitable for the nonmagnetic interlayer (e.g. see claim 2).

Request for Continued Examination

4. The Request for Continued Examination (RCE) under 37 CFR 1.53 (d) filed on May 13, 2004 is acceptable and a RCE has been established. An action on the RCE follows.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1, 2, 7 – 10 and 13 – 16 are rejected under 35 U.S.C. 102(e) as being anticipated by Mack et al. (U.S. Patent No. 6,462,919 B1) as evidenced by Slaughter (U.S. Patent No. 6,549,454 B1).

Regarding claims 1 and 2, Mack et al. disclose a magnetic sensing element (*Title*) comprising a laminate, the laminate including: a first antiferromagnetic (AFM) layer (*Figure 6B, layer 238*), a pinned magnetic layer (*layer 236*), a magnetization direction thereof being pinned by the first AFM layer (*col. 6, lines 51 – 55*), a nonmagnetic layer (*layer 234*), a free magnetic layer (*layer 232*), a magnetization direction thereof being variable in response to an external magnetic field (*col. 6, lines 49 – 51*), a nonmagnetic interlayer (*layers 230A and 230B*), a ferromagnetic layer (*layers*

228A and 228B) and a second AFM layer (*layers 22A and 22B*), which magnetically couples with the ferromagnetic layer to orient a magnetization of the ferromagnetic layer in a predetermined direction (*col. 6, lines 51 – 55 and col. 8, lines 34 – 64*), wherein the laminate has a recess extending through the second AFM layer and the ferromagnetic layer (*Figure 6B*), a bottom face of the recess lying in the nonmagnetic interlayer (*col. 4, line 61 bridging col. 5, line 11 and col. 11, lines 26 – 31*), a width of the bottom face in a track width direction being equal to a track width (*Figure 6A "Track Width"*), wherein the free magnetic layer is magnetized in a direction substantially orthogonal (i.e. perpendicular) to the magnetization direction of the pinned magnetic layer as a result of magnetic coupling with the ferromagnetic layer (*col. 1, lines 45 – 52 and col. 12, lines 41 – 55*).

Regarding the limitation "nonmagnetic conductive layer", the Examiner notes that Mack et al. explicitly discloses that the MR element is a giant magnetoresistive element (GMR element) (*col. 8, lines 34 – 35*) and that the nonmagnetic layer between the free and pinned layer is inherently a conductive layer, as evidenced by Slaughter (*col. 1, lines 21 – 26: "In a GMR material, the spacer layer is conductive, while in a TMR material, the spacer layer is insulating"*).

Regarding the limitation "wherein a portion of the nonmagnetic layer corresponding to the bottom face of the recess ... sensing element", this limitation is deemed to be inherently met by any of the materials disclosed by applicants as being suitable for the nonmagnetic interlayer (i.e. claim 2) (*col. 9, lines 1 – 2*) The Examiner

further notes that Mack et al. explicitly teaches that the MR ratio increases when the nonmagnetic interlayer is only partly etched (*Figure 9B and col. 11, lines 1 – 8*).

Regarding claim 7, Mack et al. disclose side faces that are perpendicular to the track width direction (*Figures 6A and 6B*).

Regarding claims 8 - 10, Mack et al. disclose a nonmagnetic layer meeting applicants' claimed structural and material limitations (*Figure 6B, elements 226A and 226B and col. 8, line 34 bridging col. 9, line 12*).

Regarding claims 13 and 14, Mack et al. disclose that a synthetic pinned structure comprises a plurality of ferromagnetic sublayers, each differing in a magnitude of a magnetic moment per unit area, and at least one nonmagnetic intermediate sublayer meeting applicants' claimed material limitations (claim 14) separating the plurality of ferromagnetic sublayers from one another, wherein the magnetization directions of the plurality of ferromagnetic sublayers are antiparallel to each other (*col. 8, lines 38 – 50 and claims 1 - 9*) is known as a synthetic AFM (SAF) structure and that the pinned layer (*Figure 6B, layer 236*) can also comprise such a structure (*col. 9, lines 10 – 11: "Pinned layer **236** may also be a SAF structure to provide enhanced stiffness"*).

Regarding claim 15, Mack et al. teach using antiferromagnetic materials having high coupling constants and blocking temperatures for strong exchange coupling between the antiferromagnetic layers and the ferromagnetic layers, with PtMn being the preferred alloy (*col. 7, line 66 bridging col. 8, line 34*). While Mack et al. does not explicitly disclose what materials are used for both the first and second AFM layers, given the limited choice of AFM materials listed, the Examiner deems that one of

ordinary skill in the art would readily recognize that Mack et al. discloses embodiments wherein all the AFM layers can be the same AFM material.

Regarding claim 16, Mack et al. disclose AFM materials meeting applicants' claimed material limitations (*col. 7, line 66 bridging col. 8, line 34*).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mack et al. as evidenced by Slaughter as applied above.

Mack et al. and Slaughter are relied upon as described above.

Regarding claim 15, while the Examiner deems that Mack et al. provides sufficient teaching for using the same AFM material for the first and second AFM layer, the Examiner notes that Mack et al. does not explicitly provide any embodiments meeting the claimed limitation.

Therefore, in the event that such an embodiment would not have been readily envisioned by one of ordinary skill in the art, the Examiner notes that Mack et al. teach that PtMn is a preferred AFM material since is possesses good AFM properties and good corrosion resistance and it would have been obvious to one of ordinary skill at the time of applicants' invention to make both AFM layers out of a PtMn alloy since then

both AFM layers would possess good AFM properties as well as good corrosion resistance.

9. Claims 3 – 6, 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mack et al. as evidenced by Slaughter as applied above, and further in view of Sakakima et al. (U.S. Patent App. No. 2003/0197505 A1).

Mack et al. and Slaughter are relied upon as described above.

Mack et al. fail to disclose using a CoFeNi alloy meeting applicants' claimed limitations as the free and/or ferromagnetic layer.

However, Sakakima et al. teach that CoFeNi alloys meeting applicants' claimed composition limitations are preferred for the free magnetic layer and/or the ferromagnetic layer making up a synthetic pinned structure inorder to obtain a large MR ratio (*Paragraphs 0105, 0111 and 0120*).

It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of Mack et al. to use a free and/or ferromagnetic layer meeting applicants' claimed FeCoNi compositions as taught by Sakakima et al. since such compositions are preferred for the free and/or ferromagnetic layer inorder to obtain a large MR ratio.

Regarding claim 4, Sakakima et al. disclose using interlayers meeting applicants' claimed structural and composition limitations inorder to increase the MR ratio of the sensor (*Paragraph 0130*).

Regarding claims 13 and 14, while the Examiner deems that Mack et al. provides sufficient disclosure for the claimed limitations, the Examiner notes that Mack et al. fails to explicitly state that the plurality of sublayers differ in magnitude of a magnetic moment (i.e. saturation magnetization x magnetic layer thickness product).

Therefore, in the event that such an embodiment would not have been readily envisioned by one of ordinary skill in the art, Sakakima et al. teaches that it is known in the art to control the magnetic moments to be different in both direction and magnitude since such a structure will virtually decrease the thickness of the pinned layer to the difference between the thicknesses (magnetization) of the two synthetic antiferromagnetic layers (*Paragraphs 0107, 0183, 0239 and Examples 15 – 17, where the Examiner notes the{* $Co_{0.9}Fe_{0.1}$*/Ru/*$Co_{0.9}Fe_{0.1}$*} laminate adjacent to the AFM PtMn layer is a synthetic pinned layer*).

10. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mack et al. evidenced by Slaughter as applied above, and further in view of Arai et al. (JP 11-175919 A). See provided English Translation of JP '919 A.

Mack et al. and Slaughter are relied upon as described above.

Mack et al. fail to disclose a third AFM layer meeting applicants' claimed structural and thickness limitations.

However, Arai et al. teach that using an AFM structure comprising a third AFM layer in contact with the ferromagnetic layer (i.e. under the second AFM layer) possessing a thickness meeting applicants' claimed limitations (*Paragraph 0009*) results

in a thin overall AFM structure with high exchange coupling and high blocking temperature (*Paragraph 0008*).

It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of Mack et al. to use a third AFM layer meeting applicants' claimed structural and thickness limitations as taught by Arai et al. inorder to produce a thin overall AFM structure with high exchange coupling and high blocking temperature.

Response to Arguments

11. The prior rejection of claims 1 - 16 under 35 U.S.C § 103(a) – Seyama et al in view of Mack et al. and Torng et al.

Applicant's arguments have been considered but are moot in view of the new ground(s) of rejection. In so far as they apply to the rejections of record, applicant(s) argue(s) that the "spin filter effect is not taught or suggested by Mack" (*page 7 of response*), thereby distinguishing the invention over the Mack et al. invention. The examiner respectfully disagrees.

The Examiner notes that the claimed limitation is a functional limitation that is dependent on the material and structural location of the layer. Since Mack et al. disclose an identical material as used by applicants (i.e. Ru) in an identical location (between the AFM longitudinal biasing layers and the free layer), the Examiner deems that there is sound basis for a position that the Ru layer would necessarily product a spin filter effect, especially given the teachings in Mack et al. regarding explicit

embodiments wherein the Ru layer is not fully etched away and the corresponding increase in MR properties (*Figures 9B, 11A, 12A and col. 11, lines 1 – 8*). As such, the Examiner deems that Mack et al. provides clear teaching that the Ru layer should not be fully removed, thereby leaving a layer identical in both material and composition to applicants' disclosed layers. Therefore, there is sound basis that such a layer would inherently exhibit a spin filter effect.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin M Bernatz whose telephone number is (571) 272-1505. The examiner can normally be reached on M-F, 9:00 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Thibodeau can be reached on (571) 272-1516. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Kevin M. Bernatz, PhD
Primary Examiner

July 20, 2004